PLAN FOR A WORKSHOP
ON LARGE-SCALE OBSERVING SYSTEMS
IN THE CONTEXT OF SEARCH

Sponsored by the
Interagency Working Group
for the Study of Environmental Arctic Change (SEARCH)

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1.   Introduction

The Arctic environment has undergone significant changes in the last thirty years. These changes have accelerated over the last decade and have resulted in losses of sea ice and snow cover and shifts in the Icelandic and Aleutian Low mid-latitude weather systems. Such changes now have demonstrable impacts on land and oceanic ecosystems and human activities (SEARCH Science Plan, http://psc.apl.washington.edu/search). The future in the Arctic is likely to be significantly different than the present or the past.

The SEARCH Science Plan provides a review of recent Arctic observations, four science hypotheses, and a strategy for the program. This Plan is augmented by a list of science questions proposed at the Joint Interagency Working Group/Science Steering Committee Meeting in August 2001. Science drivers for SEARCH include:

- Which Arctic changes reflect basin-wide, decadal and long-term processes and how are they coupled?
- Have feedbacks within the Arctic amplified these changes?
- What are some future Arctic change scenarios?

A major task for SEARCH, in addressing the previous questions, is to determine how existing observation systems can be best used and enhanced to understand and predict the ongoing changes in the Arctic. This task is difficult because many routine observations were not designed specifically for climate study purposes. Such an analysis is far more complex than designing a limited regional field experiment. We propose to address this task through a workshop to be held in Seattle, Washington on 27-29 November 2001. This workshop will provide a venue to discuss existing knowledge of large-scale atmospheric/cryospheric observing systems within the large-scale, multi-year context demanded by SEARCH. A preliminary meeting proposal was developed in March 2001 and presented to the SEARCH Interagency Working Group (IWG).This present document describes a plan for the workshop in more detail.

2.   Rationale

SEARCH hypotheses involve a complex of related, pan-Arctic, but regionally varying, atmospheric, oceanic, and terrestrial changes observed in the Arctic during recent decades. These changes have become apparent primarily in the context of historical data collected prior to 1990. However, over the past decade the changes appear to have accelerated and have been readily apparent over the decadal timescale. Ironically, many of the operational observing programs that produced the earlier data are gone. For example, the Russian drifting ice stations are no longer in place, and many Russian and Canadian meteorological stations are being closed or automated, with a change in data collection methodology. "If Arctic change is to be understood, we must rededicate effort to fundamental observations in the ocean, in the atmosphere and on land that continue on a regular basis for decades into the future (SEARCH Science Plan, p. 47)." We believe that a first step in accomplishing this is to assess the current state of available observational systems within a context of wide-area, long-term change.

3.   Workshop Goals and Objectives

The goal of the workshop is to assess how current observations can best be used and enhanced to understand and ultimately predict the ongoing changes in the Arctic.

The workshop objectives are to review the state of knowledge through invited speakers, foster group discussion through panels on land, sea-ice and atmospheric observations, and produce a summary report that assesses the observational needs within the context of observed and probably future changes.

A workshop planning group was established in December 2000, consisting of:

Roger Barry (International representative for CLIC)
Robin Muench (ONR, member of IWG)
James Overland (NOAA, member of SSC)
Jackie Richter-Menge (CRREL, member of IWG)
John Walsh (U. of Illinois, member of SSC)

Two members of the group are from the SEARCH Scientific Steering Committee and two are from the IWG; the intent is to keep the workshop close to SEARCH goals. R. Barry represents an international connection through CLIC (International Climate and Cryosphere Program).

A) A Distributed Observational Network

Before future change can be anticipated, we must demonstrate that models can simulate the observed past and present changes. This requires identification and assimilation of long-term data sets into the models. Ongoing climate change can only be documented and understood through maintaining and characterizing real-world observations and assimilating them into state-of-the-art models. For this to have meaning in a SEARCH context, ongoing data collection will be required over a planned, distributed observational network.

An essential first step in this process of assessment is to obtain more rigorous information on what observing systems are available and what scientific uses were, and are, being made of the data. We focus on physical data, not to exclude other important indicators, but to impose reasonable limits on the scope for a working meeting and provide a pilot for how other types of data might be assessed. The observational network would build on existing and new observations to monitor key atmospheric and cryospheric indicators to facilitate early detection of changes in the land-ice-atmosphere system. Atmospheric parameters might include pressure, temperature, radiative fluxes, air chemistry, cloud precipitation, weather systems, and sea surface temperatures, while cryospheric indicators include surface albedo, snow cover, sea-ice thickness and extent, vegetation changes, glaciers, river discharge, and permafrost. These data are required as baseline information for modeling studies which are essential, in turn, for predicting future change. We anticipate a combination of information from satellite sensors, widely distributed observations such as the WMO (World Meteorological Organization) network and drifting ice buoys, and enhancement of additional intensive sites (like the Barrow Observatory) in complementary locations.

In keeping with the broad SEARCH hypotheses, we will discuss an observational network with an emphasis on:

     i.   Observations which are pan-Arctic and encompass large spatial regions. Observations should resolve variability on a scale of 500 km, which is typical of meteorological length scales.

    ii.   Observations should be located in regions of large decadal variability. Priority should be given to locations with historical time series in such locations.

   iii.   Observations must be multi-variate. Detection and prediction is improved by using several indicators.

   iv.   Observations must be accessible. This includes future observations and making available retrospective data sets, for example, intercalibrated TOVS satellite-derived gridded temperature sounding data and Russian data from the 1990s.

Thus, an observational network in the context of SEARCH is a collection of operational observing sites, satellite information and specific observational enhancements, which conform to the above general criteria. The assessment at the workshop is to refine this definition.

B) An Arctic System Reanalysis

Hemispheric reanalyses have been conducted at three major climate centers where models with assimilated data have been run covering recent past periods ranging in length from 15 to 50+ years and with fixed physical parameterizations. Reanalyses assimilate basic data, such as geopotential height and winds, and also provide secondary derived quantities such as heat and moisture fluxes, which are difficult to measure directly over long periods of time. However, the currently available 4-D modeled data sets are not optimized for Arctic processes nor do they include major Arctic data sets. Validation of these reanalyses in the Arctic has been inconsistent. The workshop will explore developing a retrospective and prospective Arctic reanalysis. Here, prospective means an ongoing update through the SEARCH project. Such an approach would include assembly and assimilation of Arctic specific data, such as recalibrated satellite sounder temperature data (TOVS), ISCCP cloud data, the recently available data from the U.S. – Russian atlas, as well as other conventional data. The same models would be used to develop future change scenarios. An Arctic System Reanalysis would also go farther than providing standard atmospheric parameters similar to the climate centers, to include sea ice, land and upper ocean components.

4.   Meeting Plan

A) Format

We have reserved meeting space at the Student Union (HUB) on the University of Washington campus for 27-29 November 2001. We have contacted 33 scientists, each of whom has agreed to present an overview paper or serve on a panel. An announcement of the meeting was posted to the community the first week of September by way of the ARCUS (Arctic Consortium of the US) information net. We anticipate that 50-70 investigators will attend. The meeting will cover four areas: land, sea-ice, and atmospheric observations, and components of an Arctic system reanalysis.

The first day is scheduled for the invited presentations. The meeting is planned to begin with a brief presentation on SEARCH and that will summarize SEARCH goals and emphasize how the workshop will support SEARCH objectives. This will be followed by talks which summarize the latest understanding on Arctic changes, and review the current status of several types of observations such as land cover, sea-ice thickness, WMO observations and measurements at intensive sites (see Agenda attachment). Components of an ongoing Arctic system reanalysis will be presented. Because prediction is a goal of SEARCH, a final talk will show the current status of coupled GCM models for the Arctic from the Arctic modeling intercomparison project.

The second and third days will be organized to provide opportunities for discussion of observing systems. Four half-day panels will focus on land, sea-ice, and atmosphere observations, and an Arctic system reanalysis. Members of each panel will provide introductory statements and the chair will promote discussion by the entire group. In keeping with the integrated nature of SEARCH, we will not break into topic subgroups. The third day will end with a summary by panel chairs and comments by Howard Cattle on international connections.

B) White Papers

Meaningful discussion of several of the complex topics that the workshop plans to address will require information to be gathered before the workshop and made available to participants. This information will take the form of white papers and will include reports on present and previous status of WMO station observations, satellite sensors, location and data variables for intensive observation sites, and accuracy of global reanalyses in the Arctic.

Before the meeting, each participant will receive an information packet on SEARCH, the role of the meeting in SEARCH and the white papers.

C) Meeting Results

A workshop report will summarize the presentations, contain detailed summaries of the four panel discussions, and provide a report on the status of large-scale observations suitable for SEARCH. The planning group will meet the day following the workshop to draft this summary, in order to allow the workshop to focus on its primary agenda of discussion and concept promotion.

This report will provide information and recommendations to the IWG and Science Steering Committee concerning a potentially complimentary atmospheric/cryospheric mix of observations for SEARCH based on existing observations and definition of significant data gaps. The summary would provide information on how SEARCH might expand to include broader observation systems, e.g., biological systems. The workshop will provide momentum to the SEARCH program by publishing a meeting summary, composed by the workshop planning group, in the Bulletin of the American Meteorological Society. The workshop report and meeting summary will be completed early in 2002.